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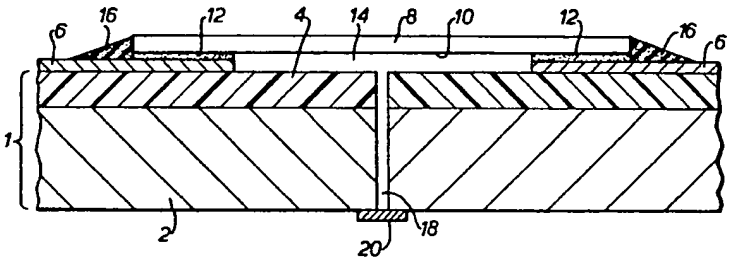
(54) Mounting surface acoustic wave components

(57) A surface acoustic wave (SAW) component (8) is mounted face down on a printed wiring substrate (1) with the surface transducers arranged in alignment with respective conductors (6) on the printed wiring substrate (1). The conductors and transducers are connected together by conductive epoxy adhesive (12). A fillet (16) of room temperature vulcanising (RTV) adhesive is applied all around the SAW component (8) to prevent ingress of moisture, solvents, etc. An air gap (14) is formed between the transducer-carrying surface (10) of the SAW component (8) and the surface of the printed wiring substrate (1) by the slightly raised nature of the conductors (6). A bleed hole (18) allows back filling of the gap (4) with an inert gas e.g. nitrogen and subsequent sealing with a disc (20).



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The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

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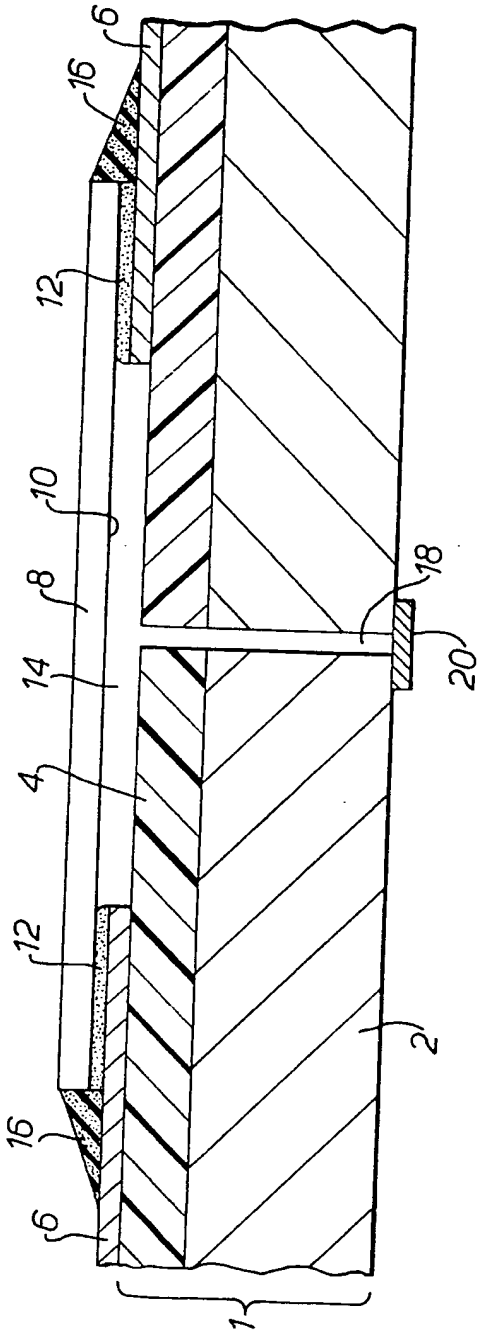

SPECIFICATION

Mounting saw components

The present invention relates to methods of mounting surface acoustic wave (SAW) components to substrates such as circuit boards.

Conventionally, SAW components such as delay lines and filters have been mounted to printed circuit boards (PCBs) by first packaging them into sealed containers having externally projecting connecting pins which are then soldered to tracks already printed on the circuit board. It is thus necessary to connect wire bonds from the transducers of the SAW device to each of the pins and then enclose the connected SAW device into a sealed package. This form of mounting is both bulky and relatively expensive, as many of the pins require glass to metal seals for isolation from the body of the package.

It is presently becoming increasingly the practice to mount components directly to the surface of a circuit board substrate. This technique is known as surface mounting and has been used for mounting integrated circuits. The packages, instead of having pins, are provided simply with bonding pads at their edges or on their lower surface which can be directly connected to correspondingly arranged pads on the surface of the printed circuit board by thermocompression bonding or soldering. This method has the advantage of producing a very low profile assembly but does not avoid the bulk and expense of packaging.

It would be clearly advantageous to be able to mount SAW devices directly onto printed wiring substrates without the expense and bulk of packaging by, for example, bringing the bond pads of the device into direct contact with the printed wiring substrate. However, the problem of providing a sealed air space adjacent to the active region of the device surface has to be overcome, as this surface must be kept free from contact with any other surface and from contamination of any kind which would impede the propagation of surface waves. Further, without a conducting metal package the problem of providing suitable electromagnetic screening must also be overcome.

Finally, SAW devices may be fragile, and sensitive to stress caused by differential thermal expansion if directly adhered to a rigid surface with a much different coefficient of expansion. They can also be damaged by direct application of heat.

The present invention accordingly provides a method of mounting an unpackaged SAW component having transducers on one surface of a substrate, to a printed wiring substrate carrying conductors to be connected to the SAW transducers, comprising the steps of applying a conductive adhesive to predetermined areas of said one surface of the SAW component and/or of the printed wiring substrate, placing said one surface of the SAW component over the printed wiring substrate such that the transducers are in contact, via the adhesive, with the conductors to which they are to be connected and a space is defined between said one surface of the SAW component and the printing wiring substrate, and sealing said space.

The use of a conducting adhesive, for example a conducting, silver-loaded epoxy resin, avoids the need for gold wire bonding or application of heat to the SAW component.

In order to define the space, the conductors on the printed wiring substrate are preferably slightly raised from the surface of the substrate, so that when the component is inverted over the substrate a small air gap results. This gap prevents any adverse effect that surface contact between the substrate and the SAW component would have on the surface waves produced during operation of the component. In a preferred embodiment means are provided for filling this space with a dry inert gas such as nitrogen for better operating conditions.

Preferably sealing is ensured by applying a fillet of non-conductive, flexible adhesive all around the edge of the SAW component between the component and the printed wiring substrate to prevent the ingress of moisture, solvents or dirt which could have an adverse effect on the operation of the component if allowed to become deposited on the surface carrying the transducers. A suitable adhesive for this fillet is a room temperature vulcanising synthetic rubber adhesive. This advantageously has the further property of absorbing any residual acoustic energy impinging on the edge of the component.

Another problem associated with the surface mounting of SAW components is the avoidance of stress on the component which may cause changes in the response of the transducers due to variation of the stress of the mount. The use of the above-mentioned flexible adhesive fillet as set out above helps in the removal of such stress. In accordance with a preferred embodiment of this invention the printed wiring substrate is a soft circuit board substrate such as a polytetrafluroethylene-based dielectric material. It will be noted that such substrates are cost effective compared with harder substrates but they are not ideal for the use of thermocompression bonding techniques, and therefore the adhesive mounting technique of the present invention is highly advantageous in enabling further reduction of stress in the mounting of the SAW component.

It is preferable that the printed wiring substrate has a stiffening backing such as an aluminium plate on the surface directly opposite the SAW component. Conveniently, this may provide an excellent ground plane for electro-

magnetic screening.

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying diagrammatic drawing which shows a cross-section through a SAW component mounted to a printed wiring substrate in accordance with the invention.

A printed wiring substrate 1 comprises a metal substrate backing plate 2 provided with an upper, dielectric layer 4. The plate 2 may be an aluminium plate and provides stiffening and a ground plane for electromagnetic screening. In a soft printed wiring substrate the dielectric layer 4 may be based on polytetrafluroethylene material and is relatively resilient.

A pattern of conductors 6 is applied to the surface of the dielectric layer 4 to establish the interconnections required between a SAW component 8 and other components to be mounted on the substrate 1. The conductors are preferably gold plated copper tracks. The SAW component 8 comprises in a known manner a substrate of, for example, quartz on which an aluminium surface film (not shown) has been applied to the face 10 in an appropriate pattern to form the surface acoustic wave transducers of the component. Each transducer is normally required to be connected to a particular conductor on the printed wiring substrate. The terminations of these conductors are arranged so that when the component 8 is placed with its active surface 10 facing towards the substrate 1 the various portions of the transducers to be connected are aligned with their respective conductors.

In order to achieve a connection between the transducers and conductors 6 a conductive epoxy adhesive 12 is applied in appropriate predetermined regions either to the surface of the printed wiring substrate 1 or to the surface 10 of the SAW component or to both surfaces. The application of the adhesive may be such as to cover only those areas between the conductors 6 and transducers to be connected or may extend more widely so that a bond can be formed between the conductor and the SAW substrate in order to give improved adhesion. It will be appreciated that the pattern of adhesive must be arranged so as to avoid producing an electrical connection between the different transducers. A silver loaded epoxy resin is a suitable adhesive for this purpose.

The pattern and height of the conductors 6 is such that when the SAW component is mounted face down on top of the conductors a small air gap 14 is formed between the transducer-carrying surface 10 of the component and the surface of the dielectric material 4. This prevents any adverse effects on the propagation of the surface acoustic waves that could be caused by surface contact between the dielectric material 4 and the SAW component 8.

In order to avoid the ingress of moisture, solvents or dirt, a fillet of non-conducting flexible adhesive 16 is applied all around the edge of the SAW component. A suitable adhesive for this purpose is a room temperature vulcanising (RTV) synthetic rubber adhesive.

A bleed-hole 18 is provided to allow back filling of the air gap 14 with inert gas, such as nitrogen. A small disc 20 is stuck down with adhesive, e.g. epoxy, to reform the seal after the inert gas has been introduced to replace the air. The hole 18 may also be used to attach equipment to test the seal between the component 8 and the substrate 1.

The above described mounting technique may be used on printed circuit boards to which other components are mounted by either through hole or surface mounting. For hybrid circuits the entire assembly together with other components mounted to the printed wiring substrate 1 may be encapsulated in non-conducting epoxy for ruggedness and improvement of the seal. Conductive paint or metal foil may also be applied to the back of the SAW component to improve electromagnetic screening.

Because of the presence of the fillet 16 the surface 10 of the SAW component is not affected by deposit of any products emanating from this epoxy which could have an adverse effect on the operation of the SAW component.

The material of the plate 2 is preferably chosen so that the coefficient of expansion of the substrate 1 is as similar as possible to the coefficient of expansion of the SAW component to guard against the component becoming dislodged if the assembly is subjected to wide temperature fluctuations.

In a modification the RTV adhesive can be extended to not only provide the fillet 16 but also to cover the entire back of the SAW component 8 to a depth which may be substantially equal to the thickness of the substrate of the SAW component. This layer of adhesive can then be encapsulated in a hard epoxy resin to provide mechanical protection and also to increase the longevity of the seal between the SAW component and the substrate 1, provided by the adhesive. If the encapsulating expoxy resin is conducting further electromagnetic screening is provided. Alternatively a screening metal layer may be provided inside or outside the hard epoxy encapsulation.

CLAIMS

1. A method of mounting an unpackaged SAW component having transducers on one surface of a substrate, to a printed wiring substrate carrying conductors to be connected to the SAW transducers, comprising the steps of applying a conductive adhesive to predetermined areas of said one surface of the SAW component and/or of the printed wiring sub-

strate, placing said one surface of the SAW component over the printed wiring substrate such that the transducers are in contact, via the adhesive, with the conductors to which they are to be connected and a space is defined between said one surface of the SAW component and the printing wiring substrate, and sealing said space.

2. A method as claimed in claim 1, wherein the adhesive is a conducting, silver-loaded epoxy resin.

3. A method as claimed in claim 1 or 2, further comprising the step of filling said space defined between said one surface of the 8AW component and the printing wiring substrate with a dry inert gas.

4. A method as claimed in claim 3, wherein the inert gas is nitrogen.

5. A method as claimed in any one of the preceding claims, wherein the sealing step comprises applying a fillet of non-conductive, flexible adhesive all around the edge of the SAW component between the component and the printed wiring substrate.

6. A method as claimed in claim 5, wherein the fillet is made of a room temperature vulcanising synthetic rubber adhesive.

7. A printed wiring substrate carrying a surface mounted unpackaged SAW component having transducers on one surface, the printed wiring substrate carrying conductors which, at least in the region at which they contact the transducers of the SAW component, are raised from the surface of the printed wiring substrate, said one surface of the SAW component facing the printed wiring substrate so that a space is defined between their surfaces, conducting adhesive holding the SAW component to the printed wiring substrate and making the required electrical connections between the transducers and the conductors on the printed wiring substrate, and a fillet of non-conductive, flexible adhesive surrounding the edge of the SAW component and sealing said space.

8. An assembly as claimed in claim 7, wherein the printed wiring substrate is a soft circuit board substrate.

9. An assembly as claimed in claim 8, wherein the soft circuit board substrate is a polytetrafluoroethylene-based dielectric material.

10. An assembly as claimed in any one of the preceding claims wherein the printed wiring substrate has a stiffening backing.

11. An assembly as claimed in claim 10, wherein the stiffening backing comprises an aluminium plate disposed on the surface opposite the SAW component.

12. A method of mounting an unpackaged SAW component to a printed wiring substrate substantially as herein described with reference to the accompanying drawings.

13. An assembly of an unpackaged SAW conponent on a printed wiring substrate substantially as herein described with reference to the accompanying drawings.

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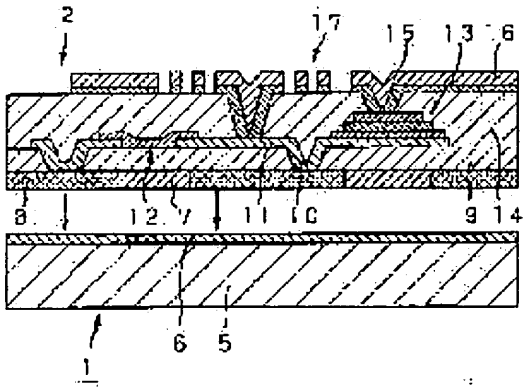
(54) CIRCUIT BLOCK BODY, ITS MANUFACTURING METHOD, WIRING CIRCUIT DEVICE, ITS MANUFACTURING METHOD, SEMICONDUCTOR DEVICE AND ITS MANUFACTURING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To contrive miniaturization and a low cost by thinning with high precision and high function.

SOLUTION: A peeling layer forming process for forming a peeling layer 6 on a main face flattening a base board 1, an insulation layer forming process for forming insulation layers 7, 9, 16 on the peeling layer 6, a wiring layer forming process for forming wiring layers 8, 11, 14 on the insulation layer 7, and a circuit block body peeling process for peeling a circuit block body 2 comprising each insulation layer and wiring layer through the peeling layer are provided. The circuit block body 2 incorporates film formation elements 12, 13, 17 in the wiring layer, and is mounted on a base board 3 to compose a wiring device. The circuit block body 2 mounts a semiconductor chip 62 on the surface and is



mounted on a base board 64 to compose a semiconductor device.